

# Test Report

**Customer:**

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## RF test report

170762-AU01+W01



Industry Industrie  
Canada Canada

**Elatec GmbH**

**RFID Reader**

TWN4 MultiTech 2 LF



The test result refers exclusively to the tested model.  
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## Accreditation:



Test Firm Type "accredited": Valid until 2019-05-06  
MRA US-EU, FCC designation number: DE0010  
BnetzA-CAB-02/21-02/04 Valid until 2018-11-27

Industry Canada test site numbers with registration expiry date:  
3472A-1, expiring 2018-11-09  
3472A-2, expiring 2018-11-12

## Test Laboratory:

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The technical accuracy is guaranteed through the quality management of the  
EMV **TESTHAUS** GmbH



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# 1 Test regulations

47 CFR Part 2: 10-2017	Code of Federal Regulations Part 2 (Frequency allocation and radio treaty matters; General rules and regulations) of the Federal Communication Commission (FCC)
47 CFR Part 15: 10-2017	Code of Federal Regulations Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC)
ANSI C63.10:2013-06	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
FCC KDB 174176 D01 June 3, 2015	AC power-line conducted emissions Frequently Asked Questions
ICES-003 Issue 6, January 2016	Spectrum Management and Telecommunications Interference-Causing Equipment Standard Information Technology Equipment (ITE) – Limits and methods of measurement
RSS-Gen Issue 4, November 2014	Spectrum Management and Telecommunications Radio Standards Specification General Requirements and Information for the Certification of Radiocommunication Equipmment
RSS-210 Issue 9, August 2016	Spectrum Management and Telecommunications Radio Standards Specification Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment



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## 2 Summary of test results

Standard	Test result
47 CFR Part 15, sections 15.207 and 15.209	Passed
RSS-210 Issue 9 Section 4.3 (with appropriate references to RSS-Gen Issue 4)	Passed

Straubing, October 10, 2017



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Andreas Menacher  
Test engineer  
EMV **TESTHAUS** GmbH



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Christian Kiermeier  
Head of EMC department  
EMV **TESTHAUS** GmbH



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### 3 Equipment under Test (EUT)

Product type: RFID Reader  
Model Name: TWN4 MultiTech 2 LF  
Applicant: Elatec GmbH  
Manufacturer: Elatec GmbH  
Serial number: 2017241400  
FCC ID: WP7TWN4F7  
IC certification number: 7948A-TWN4F7  
Application frequency band: n/a  
Frequency range: 125 kHz  
Operating frequency: 125 kHz  
Number of RF-channels: 1  
Modulation: ASK  
Antenna types: PCB antenna  
 detachable  not detachable

Power supply: USB powered  
nominal: 5.0 VDC  $\pm$  15 %

Temperature range: -20°C to +50°C

Remark:  
The tests were performed with 120V AC / 60Hz.



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### 3.1 Photo documentation

For external photos of the EUT see annex B, for internal ones see annex C.  
For photos taken during testing and including EUT-positions see annex A.

### 3.2 Short description of the EUT

EUT is a RFID reader working on the frequency 125 kHz.

### 3.3 Operation mode

During the pre-tests it was observed that the “continuous-tag-reading-mode” is the respective worst- case. Therefore this mode was selected for final testing. The device was configured by manufacturer to activate the RFID reader for continuous transmission via RFID card.

The EUT was tested in 3 orthogonal positions. This is documented in annex A.



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### 3.4 Configuration

The following peripheral devices and interface cables were connected during the tests:

<i>Device</i>	<i>Type designation</i>	<i>Serial or inventory no.</i>	<i>Manufacturer</i>
RFID Reader	TWN4 MultiTech 2 LF	2017241400	Elatec GmbH
RFID tag	125 kHz	---	---
Notebook	Lifebook S760	DSBF025201	Fujitsu
AC power source (120 V / 60 Hz)	Chroma 616062	E00633	Chroma

### 3.5 Used cables

<i>Port</i>	<i>Classification</i>	<i>Cable type</i>	<i>Cable length</i>	
			<i>used</i>	<i>maximum<sup>1</sup></i>
USB cable	signal/control	Shielded	2 m	2 m

<sup>1</sup> As specified by applicant



# 4 AC power line conducted emissions

according to 47 CFR Part 15, section 15.207, and  
RSS-210, section 3.1 with RSS-Gen, section 8.8

## 4.1 Test instruments

Type	Designation	Manufacturer	Inventory no.
<input checked="" type="checkbox"/> Shielded room	P92007	Siemens Matsushita	E00107
<input type="checkbox"/> EMI test receiver	ESCI 3	Rohde & Schwarz	E00001
<input checked="" type="checkbox"/> EMI test receiver	ESCS 30	Rohde & Schwarz	E00003
<input checked="" type="checkbox"/> Artificial mains network	ESH2-Z5	Rohde & Schwarz	E00004
<input type="checkbox"/> Artificial mains network	ESH2-Z5	Rohde & Schwarz	E00005
<input checked="" type="checkbox"/> Attenuator (10 dB)	50FHB-010-10	JFW Industries	E00471
<input checked="" type="checkbox"/> Measurement software	E10	EMV TESTHAUS GmbH	E00443
<input type="checkbox"/> Measurement software	EMC 32	Rohde & Schwarz	---
<input checked="" type="checkbox"/> Cable set	RF cable	Huber + Suhner	E00424

## 4.2 Limits

Frequency [MHz]	Quasi-peak [dB $\mu$ V]	Average [dB $\mu$ V]
0.15 – 0.5	66 – 56	56 – 46
0.5 – 5.0	56	46
5 – 30	60	50



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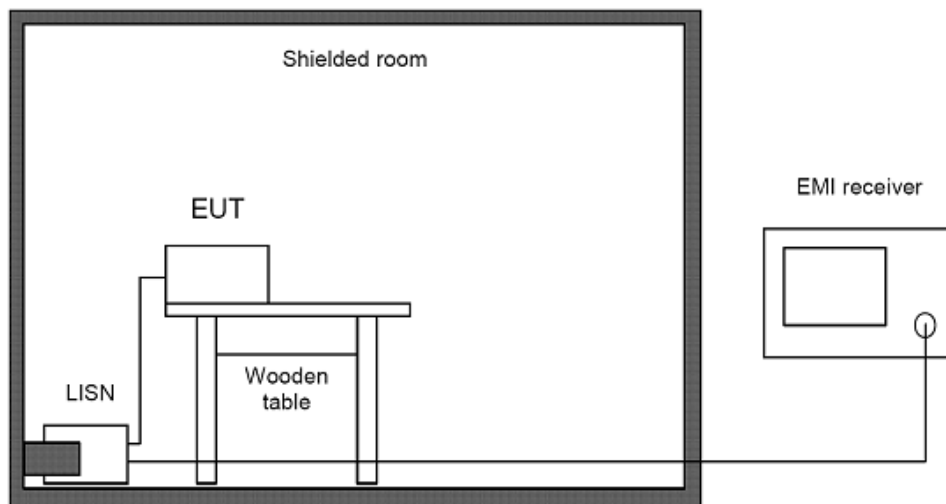
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### 4.3 Test procedure

1. The tests of conducted emission were carried out in a shielded room using a line impedance stabilization network (LISN) 50  $\mu$ H/50 Ohms and an EMI test receiver.
2. The EMI test receiver was connected to the LISN and set to a measurement bandwidth of 9 kHz in the frequency range from 0.15 MHz to 30 MHz.
3. The EUT was placed on a wooden table and connected to the LISN.
4. To accelerate the measurement the detector of the EMI test receiver was set to peak and the whole frequency range from 0.15 MHz to 30 MHz was scanned.
5. After that all peaks values with less margin than 10 dB to quasi-peak limit or exceeding the limit were marked and re-measured with quasi-peak detector.
6. If after that all values are under the average limit no addition measurement is necessary. In case there are still values between quasi-peak and average limit then these values were re-measured with average detector.
7. These measurements were done on all power lines.

According to ANSI C63.10, section 6.2.2 testing of intentional radiators with detachable antennas shall be done with a dummy load otherwise the tests should be done with connected antenna and if adjustable fully extended.

### 4.4 Test setup

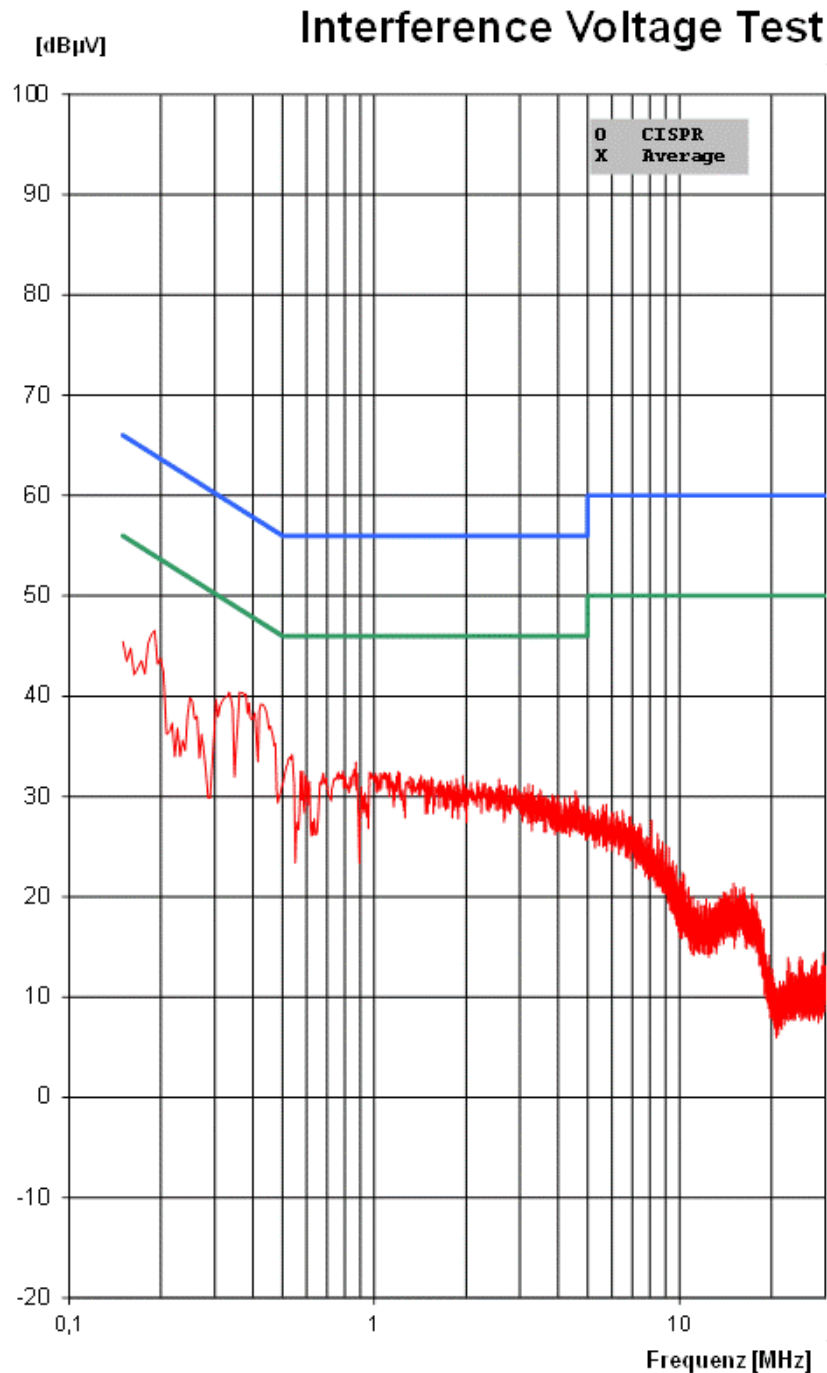


Picture 1: Outline of conducted emission test setup

Comments: All peripheral devices were additionally decoupled by means of a line stabilization network.

## 4.5 Test results

Temperature:	22°C	Humidity:	41%
Tested by:	Andreas Menacher	Test date:	2017-12-05



**REGULATIONS:**  
 47 CFR Part 15.107 class B  
 PEAK / CISPR / AV

**TEST EQUIPMENT:**  
 R&S ESCS30 (E00003)  
 R&S ESH2-Z5 (E00004)

**ORDER NO.:**  
 170762-AU01+W01

**EUT:**  
 Elatec GmbH  
 RFID-Reader  
 TWN 4 Multi Tech 2 LF USB  
 2017241400

**OPERATION MODE:**  
 continuous TX

**Mains 120 VAC 60Hz  
 Phase L1**

**TEST FACILITY:**  
 EMV TESTHAUS GmbH  
 Gustav-Hertz-Straße 35  
 94315 Straubing

**DATE / TIME:**  
 05.12.2017 / 14:29:32

**TEST ENGINEER:**  
 Andreas Menacher

170762-AU01+47 CFR Part 15.107 CEM L1  
 class B, E10

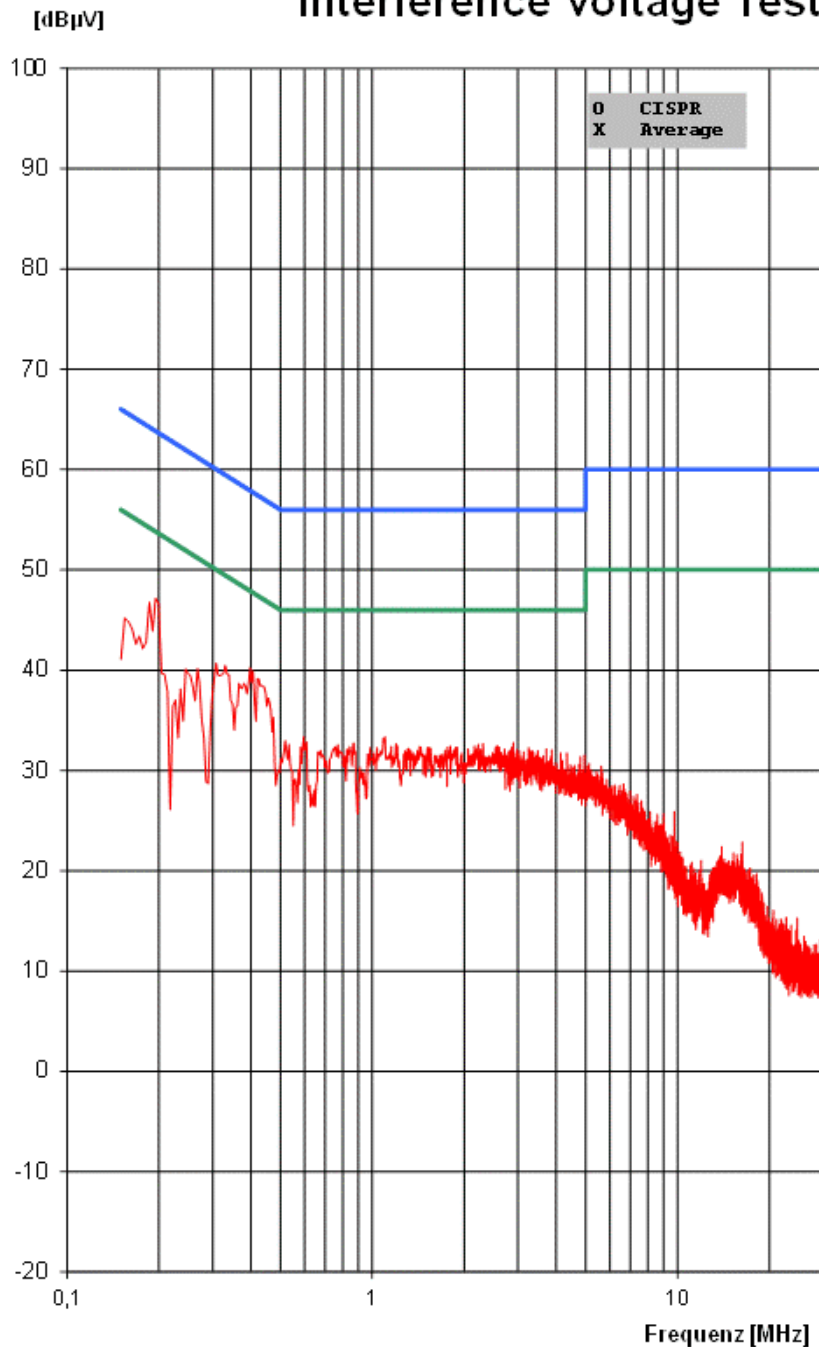
Picture 2: Graphic - Conducted emission on mains, phase 1



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# Interference Voltage Test



REGULATIONS:  
47 CFR Part 15.107 class B  
PEAK / CISPR / AV

TEST EQUIPMENT:  
R&S ESCS30 (E00003)  
R&S ESH2-Z5 (E00004)

ORDER NO.:  
170762-AU01+W01

EUT:  
Elatec GmbH  
RFID-Reader  
TWN 4 Multi Tech 2 LF USB  
2017241400

OPERATION MODE:  
continuous TX

Mains 120 VAC 60Hz  
Neutral N

TEST FACILITY:  
EMV TESTHAUS GmbH  
Gustav-Hertz-Straße 35  
94315 Straubing

DATE / TIME:  
05.12.2017 / 14:47:32

TEST ENGINEER:  
Andreas Menacher

170762-AU01+W01 47 CFR Part 15.107  
CEM N class B, E10

Picture 3: Graphic - Conducted emission on mains, neutral



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# 5 Radiated emission measurement (<1 GHz)

according to 47 CFR Part 15, section 15.205(a), 15.209(a) and RSS-210, section 4.3 with RSS-Gen, sections 8.10 and 8.9

## 5.1 Test Location

### Emission < 30 MHz

- Scan with PK / AV detector in 3 m CDC.
- Final CISPR measurement with QP detector in 3 m OATS

### Emission > 30 MHz

- Scan with QP detector in 3 m SAC.
- Final CISPR measurement with QP detector in 3 m SAC

## 5.2 Test instruments

Type	Designation	Manufacturer	Inventory no.
<input checked="" type="checkbox"/> Compact Diagnostic Chamber (CDC)	VK041.0174	Albatross Projects	E00026
<input checked="" type="checkbox"/> Semi Anechoic Chamber (SAC)	---	Albatross Projects	E00716
<input checked="" type="checkbox"/> Open area test site	---	EMV <b>TESTHAUS</b> GmbH	E00354
<input checked="" type="checkbox"/> EMI test receiver (CDC / OATS)	ESCI 3	Rohde & Schwarz	E00001
<input checked="" type="checkbox"/> EMI test receiver (SAC)	ESR 7	Rohde & Schwarz	E00739
<input type="checkbox"/> TRILOG broadband antenna (CDC)	VULB 9160	Schwarzbeck	E00011
<input type="checkbox"/> TRILOG broadband antenna (OATS)	VULB 9163	Schwarzbeck	E00013
<input checked="" type="checkbox"/> TRILOG broadband antenna (SAC)	VULB 9162	Schwarzbeck	E00643
<input checked="" type="checkbox"/> Loop Antenna	HFH2-Z2	Rohde & Schwarz	E00060
<input type="checkbox"/> Switch box	COSB 4-1-26	Conformitas	W00091
<input type="checkbox"/> Preamplifier	AMF-5D-00501800	Parzich	W00089
<input type="checkbox"/> Measurement software	E10 v1.4.12	EMV TESTHAUS GmbH	E00443
<input checked="" type="checkbox"/> Measurement software	EMC 32	Rohde & Schwarz	---
<input checked="" type="checkbox"/> Cable set SAC 3 m	---	Huber + Suhner	E00434 E00755 E00320



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## 5.3 Limits

The field strength of any emissions including spurious emissions falling into restricted bands as specified in 15.205(a) shall not exceed the general radiated emission limits as specified in 15.209.

Frequency [MHz]	Field strength Fs [ $\mu$ V/m]	Field strength [dB $\mu$ V/m]	Measurement distance d [m]
0.009 – 0.490	266.6 – 4.9	48.5 – 13.8	300
0.490 – 1.705	48.98 – 14.08	33.8 – 22.97	30
1.705 – 30.0	30	29.54	30
30 – 88	100	40	3
88 – 216	150	43.5	3
216 - 960	200	46	3
Above 960	500	54	3



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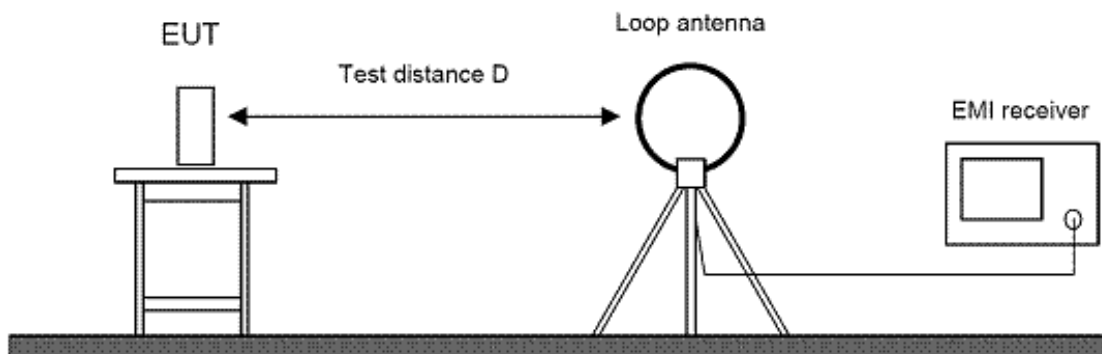
## 5.4 Test procedure

1. EUT was configured according to ANSI C63.10. It was placed on the top of the turntable 0.8 meter above ground. The receiving antenna was placed 3 meters from the turntable. The test setup was placed inside a compact diagnostic chamber.
2. EUT and all peripherals were powered on.
3. The broadband antenna was set to vertical polarization.
4. The EMI receiver performed a scan from 30 MHz to 1000 MHz with peak detector peak and measurement bandwidth set to 120 kHz.
5. The turn table was rotated to 6 different positions ( $360^\circ / 6$ ) and the antenna polarization was changed to horizontal.
6. Test procedure at step 4 and 5 was repeated.
7. The test setup was then placed in an OATS at 3 m distance and all peak values over or with less margin to the limit than 6dB were marked and re-measured with a quasi-peak detector.
8. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
9. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emission field strength of both horizontal and vertical polarization. The highest value was recorded.
10. For emissions below 30 MHz measurements were done using a loop antenna. Prescan was performed with peak detector and final measurements with quasi-peak except for the frequency bands 9 to 90 kHz and 110 to 490 k Hz where average detector applies. Antenna height was not changed during this test. Appropriate CISPR bandwidths of 200 Hz for frequencies up to 150 kHz and 9 or 10 kHz for frequencies above were used.

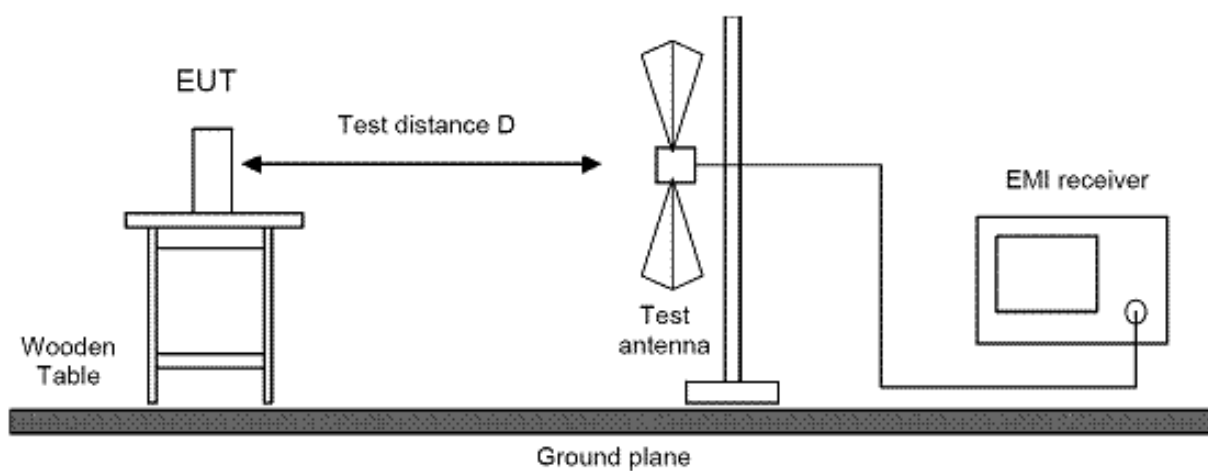




## 5.5 Test setup



Picture 4: Test setup for radiated emission measurement (< 30 MHz)



Picture 5: Test setup for radiated emission measurement (< 1 GHz)

## 5.6 Test deviation

There is no deviation from the standards referred to.

## 5.7 Test results

Temperature:	20°C	Humidity:	41%
Tested by:	Andreas Menacher	Test date:	2017-12-12

### Radiated Emission Measurement 9 kHz - 30 MHz

Recalculation factor is determined according to ANSI C63.10, section 6.4.4.2 "Extrapolation from the measurement of a single point":

$$d_{\text{near field}} = 47.77 / f_{\text{MHz}}, \text{ or}$$

$$f_{\text{MHz}} = 47.77 / d_{\text{near field}}$$

The frequency  $f_{\text{MHz}}$  at which the near field distance is equal to the limit and/or test distance is important for selection of the right formula for determining the recalculation factor:

$$f_{\text{MHz}}(300 \text{ m}) \approx 0.159 \text{ MHz}$$

$$f_{\text{MHz}}(30 \text{ m}) \approx 1.592 \text{ MHz}$$

$$f_{\text{MHz}}(3 \text{ m}) \approx 15.923 \text{ MHz}$$

For  $9 \text{ kHz} \leq f \leq 159 \text{ kHz}$  and  $490 \text{ kHz} < f \leq 1.592 \text{ MHz}$ :

$$\text{Recalculation factor} = -40 \log(d_{\text{limit}} / d_{\text{measure}})$$

For  $159 \text{ kHz} < f \leq 490 \text{ kHz}$  and  $1.592 \text{ MHz} < f \leq 15.923 \text{ MHz}$ :

$$\text{Recalculation factor} = -40 \log(d_{\text{near field}} / d_{\text{measure}}) - 20 \log(d_{\text{limit}} / d_{\text{near field}})$$

For  $f > 15.923 \text{ MHz}$ :

$$\text{Recalculation factor} = -20 \log(d_{\text{limit}} / d_{\text{near field}})$$

The limits in the graphics and value lists are derived from the general radiated emission limits as specified in 15.209 using the recalculation factor as described above.



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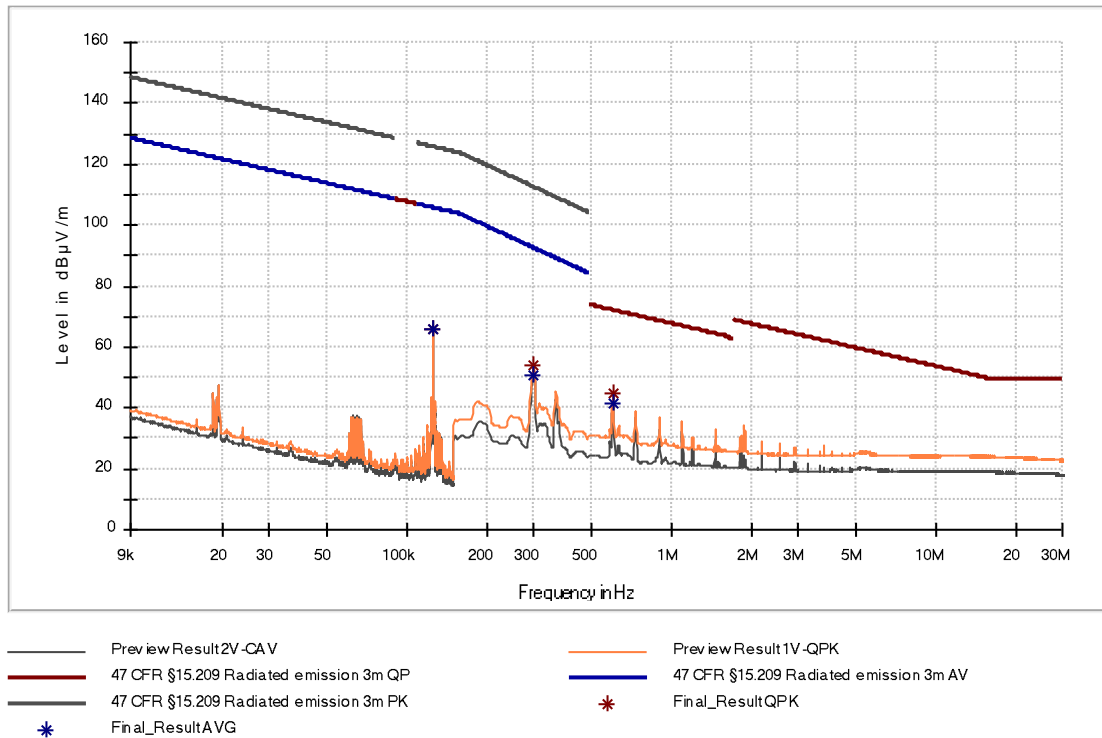
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Frequency range	Step size	IF Bandwidth	Detector		Measurement Time		Preamplifier
			Prescan	Final scan	Prescan	Final scan	
9 kHz – 90 kHz	80 Hz	200 Hz	PK	AV	1 ms	1 s	off
90 kHz – 110 kHz	80 Hz	200 Hz	PK	QPK	1 ms	1 s	off
110 kHz – 150 kHz	80 Hz	200 Hz	PK	AV	1 ms	1 s	off
150 kHz – 490 kHz	4 kHz	9 kHz	PK	AV	1 ms	1 s	off
490 kHz – 30 MHz	4 kHz	9 kHz	PK	QPK	1 ms	1 s	off

The following picture shows the worst-case-emissions for the spurious emissions at EUT-position 1, antenna parallel.



Picture 6: Radiated emission 9 kHz – 30 MHz @ 3m distance

Frequency [MHz]	Measured value [dBµV/m]	Detector	Recalculation factor [dB]	Field strength [dBµV/m]	Limit [dBµV/m]	Margin	Result
0.12500	66.17	QP	-80.0	-13,83	---	---	---
0.12500	66.01	AV	-80.0	-13.99	25.69	-39,68	Carrier
0.30075	53.89	QP	---	---	---	---	---
0.30075	50.94	AV	---	---	92.50	41.56	Pass
0.60000	45.06	QP	---	---	72.02	26.96	Pass
0.60000	41.66	AV	---	---	---	---	---



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Recalculation factor is determined according to ANSI C63.10, section 6.4.4.2 "Extrapolation from the measurement of a single point":

$$d_{\text{near field}} = 47.77 / f_{\text{MHz}}$$

$$\text{Recalculation factor} = -40 \log(d_{\text{limit}} / d_{\text{measure}})$$

<b>f<sub>MHz</sub></b> <b>[MHz]</b>	<b>d<sub>near field</sub></b> <b>[m]</b>	<b>d<sub>measure</sub></b> <b>[m]</b>	<b>d<sub>limit</sub></b> <b>[m]</b>	<b>Recalculation</b> <b>factor [dB]</b>
0.1250	382.16	3.0	300.0	-80.0



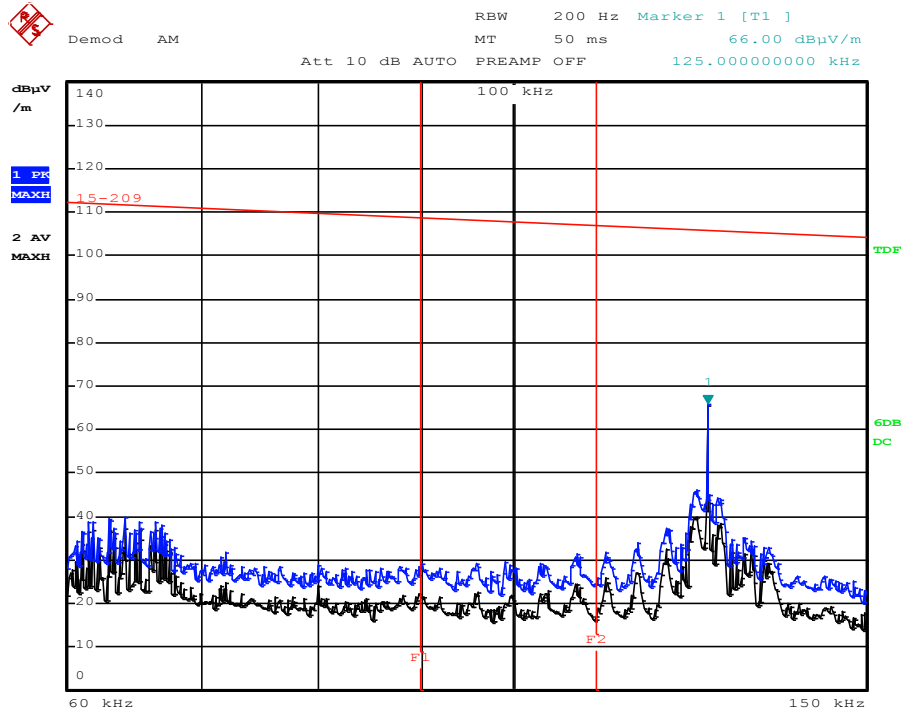
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# Restricted band of operation from 0.090 MHz to 0.110 MHz



Picture 7: Restricted band of operation, PK / AV @ 3m distance

**Note 1:**

Recalculation factor is determined according to ANSI C63.10, section 6.4.4.2 “Extrapolation from the measurement of a single point”:

$$d_{\text{near field}} = 47.77 / f_{\text{MHz}}$$

$$\text{Recalculation factor} = -40 \log(d_{\text{limit}} / d_{\text{measure}})$$

$f_{\text{MHz}}$ [MHz]	$d_{\text{near field}}$ [m]	$d_{\text{measure}}$ [m]	$d_{\text{limit}}$ [m]	Recalculation factor [dB]
0.1250	382.16	3.0	300.0	-80.0



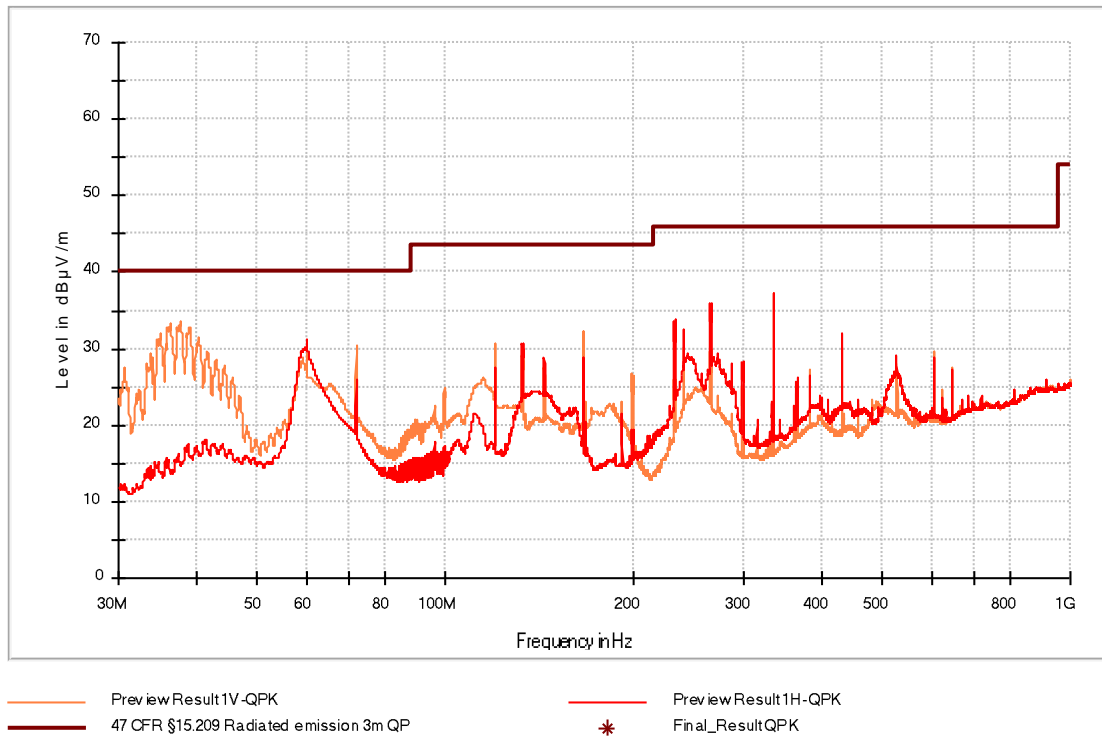
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# Radiated Emission Measurement 30 MHz - 1000 MHz

Frequency range	Polarisation	Step size	IF Bandwidth	Detector		Measurement Time		Pre-amplifier
				Prescan	Final scan	Prescan	Final scan	
30 MHz – 1 GHz	H / V	60 kHz	120 kHz	PK	QPK	1 ms	1 s	20 dB

Test was performed in standard configuration.



Picture 8: Radiated emission 30 MHz - 1000MHz @ 3m distance

Note: Chart shows maximum of horizontal and vertical polarization.

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
36.300000	32.81	40.00	7.19	---	---	100.0	V	0.0	12.4

# 6 Radiated emission measurement (>1 GHz)

according to 47 CFR Part 15, section 15.209(a),  
RSS-210, section 4.3 with RSS-Gen, section 8.9

Remark:

This measurement needs not to be applied for the RFID part because

- the intentional radiator operates below 10 GHz and tenth harmonic of the highest fundamental frequency is lower than 1 GHz (see 47 CFR Part 15, section 15.33(a)(1), and RSS-Gen, section 6.13), and
- the digital part of the device does not generate or use internal frequencies higher than 108 MHz (see 47 CFR Part 15 section 15.33(b)(1), and RSS-Gen, section 2.3.3 with ICES-003, section 6.2).



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# 7 Bandwidths

according to CFR 47 Part 2, section 2.202(a), and RSS-Gen, section 6.6

## 7.1 Test Location

See clause 5.1 on page 14.

## 7.2 Test instruments

See clause 5.2 on page 14.

## 7.3 Limits

The bandwidths are recorded only.

## 7.4 Test setup

See clause 5.5 on page 17.

## 7.5 Test deviation

There is no deviation from the standards referred to.



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## 7.6 Test results

Temperature:	20°C	Humidity:	41%
Tested by:	Andreas Menacher	Test date:	2017-12-05

### Occupied bandwidth (99 %)

#### Test procedure

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured. The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used given that a peak or peak hold may produce a wider bandwidth than actual.

The trace data points are recovered and directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded. The span between the two recorded frequencies is the occupied bandwidth. For this purpose the appropriate measurement function of the spectrum analyzer is used.

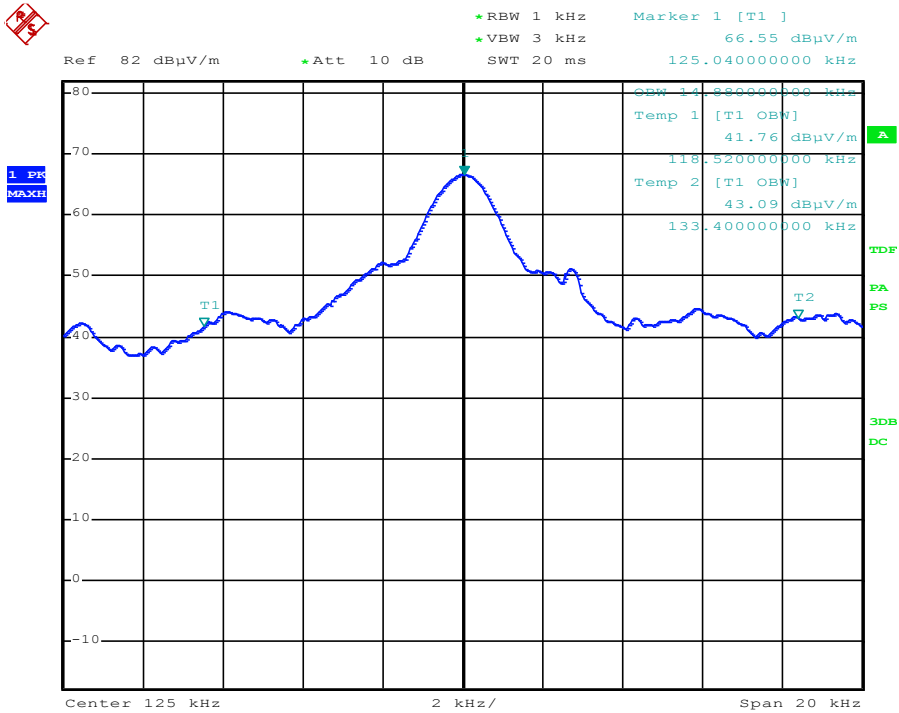


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Picture 9: Occupied bandwidth (99 %)

Measured occupied bandwidth (99 %): 14.880 kHz



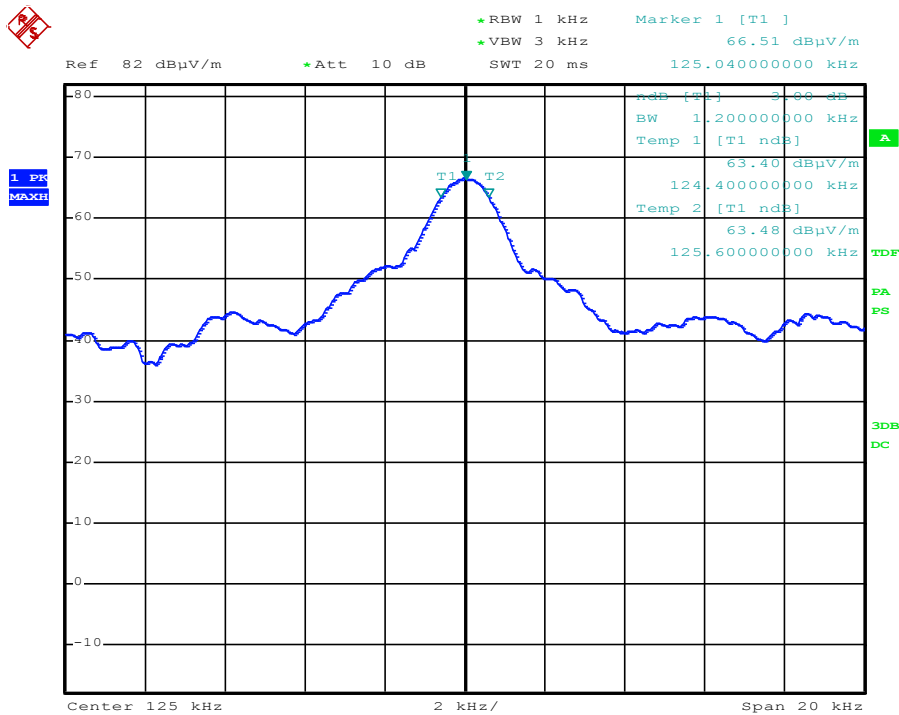
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# -20 dB emission bandwidth

## Test procedure

Where indicated, the -20 dB emission bandwidth is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated 20 dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth equal to approximately 1.0% of the emission bandwidth.



Picture 10: -20 dB emission bandwidth

Measured -20 dB emission bandwidth: 1.200 kHz



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## 8 Equipment calibration status

Description	Modell number	Serial number	Inventory number(s)	Last calibration	Next calibration
Test receiver	ESCI 3	100013	E00001	2016-02	2018-02
Test receiver	ESCI 3	100328	E00552	2016-09	2018-09
Test receiver	ESCS 30	825442/0002	E00003	2016-04	2018-04
Test receiver	ESR 7	101059	E00739	2016-02	2018-02
LISN	ESH2-Z5	893406/009	E00005	2016-02	2018-02
Loop antenna	HFH2-Z2	871398/0050	E00060	2016-09	2018-09
Broadband antenna	VULB 9162	9163-114	E00643	2015-11	2018-11
Shielded room	P92007	B83117C1109T211	E00107	N/A	
Compact diagnostic chamber (CDC)	VK041.0174	D62128-A502-A69-2-0006	E00026	N/A	
Cable set shielded room	Cable no. 30	---	E00424	2016-07	2018-07
Cable set CDC	Cables no. 37 and 38	---	E00459 E00460	2017-05	2019-05
Cable set SAC 3 m	Cables no. 04, 52 and 12	---	E00434 E00755 E00320	2017-11	2019-11

Table 1: Equipment calibration status

Note 1: Industry Canada (test sites number 3472A-1 and 3472A-2): 2018-11  
 Note 2: Expiration date of test firm accreditation for OATS and SAC: 2019-05  
 FCC test firm type "accredited": 2019-05



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## 9 Measurement uncertainty

Description	Max. deviation	k=
Conducted emission AMN (9kHz to 30 MHz)	± 3.8 dB	2
Radiated emission open field (3 m) (30 MHz to 300 MHz) (300MHz to 1 GHz)	± 5.4 dB ± 5.9 dB	2
Radiated emission absorber chamber (> 1000 MHz)	± 4.5 dB	2

Table 2: Measurement uncertainty

The uncertainty stated is the expanded uncertainty obtained by multiplying the standard uncertainty by the coverage factor k. For a confidence level of 95 % the coverage factor k is 2.



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# 10 Revision History

Date	Description	Person	Revision
2018-01-08	First edition	Andreas Menacher	0



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